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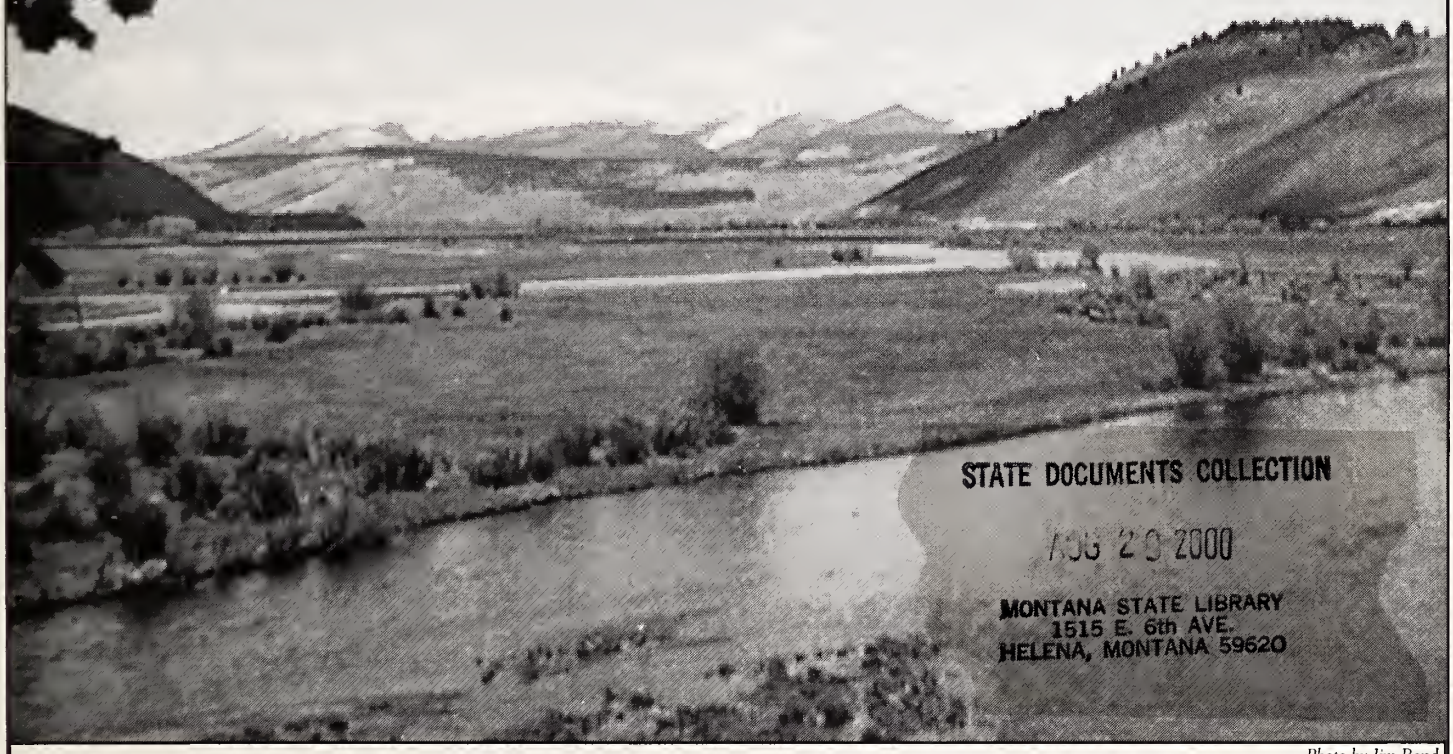
# Measuring Devices on the BIG HOLE RIVER

## — Draft Report —



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Department of Natural Resources and Conservation
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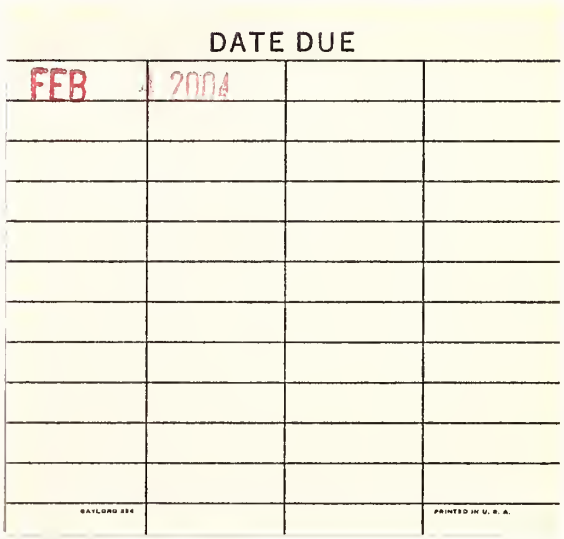
# MEASURING DEVICES ON THE BIG HOLE RIVER

## DRAFT REPORT




Prepared by

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August 1995

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# I. SUMMARY

This draft report was prepared by the Montana Department of Natural Resources and Conservation (DNRC). The report is intended partly to document DNRC's efforts to determine whether the Big Hole River meets the definition of a "Chronically Dewatered Stream," under the criteria established in Montana's Water Measurement Program (MCA 85-2-150).

This statute requires installation of water measuring and controlling devices on diversions from streams designated as "Chronically Dewatered" within two years after the designation. The report also discusses the various considerations that go into analyzing conditions on the Big Hole, and issues surrounding dewatering and the installation of measuring devices.

Section 8 of this paper, "Proposal Summary," presents DNRC's proposal that measuring devices be required on diversions from the main stem of the Big Hole between the headwaters at Jahnke Creek and the mouth near Twin Bridges. Measuring devices also are recommended for diversions from the North Fork of the Big Hole below Ruby Creek.

Following public comment on these recommendations, DNRC will make a decision as to whether the Big Hole River should be designated as chronically dewatered and present it in a final report. **DNRC will not make a decision until public comment has been reviewed.**

# II. INTRODUCTION

DNRC undertook a study of the Big Hole River to determine whether the watercourse should be designated as "Chronically Dewatered." Measuring and controlling devices are required for water diversions on designated "Chronically Dewatered" watercourses.

Information used in the study was derived mostly from existing publications. Information gathered at public meetings and from other agencies also was used in the preparation of this draft study report.

# III. BACKGROUND

## A. Water Measurement Program

The Water Measurement Program was created by the 1991 Legislature (Ch. 542, L. 1991). Under the program, measuring and controlling devices are required for diversions on watercourses that are designated as chronically dewatered. A watercourse, for the purposes of this law, is any naturally occurring stream or river from which water is diverted for beneficial uses. Once DNRC officially requires the measuring and controlling devices, they must be installed within two years (85-2-113(4)MCA); although extensions of time can be granted.

The purpose of the law is to encourage better management of water in instances where chronic dewatering significantly impairs beneficial uses. The term "dewatering" refers in this document to a reduction in streamflow beyond the point where beneficial uses are affected. Beneficial uses considered for the purposes of this study include but are not limited to fisheries, agriculture, industrial, municipal, and recreational uses. If DNRC requires the devices on the Big Hole or portions of the Big Hole, water users will be responsible for installing them.

# IV. METHODOLOGY

## A. Designation Process

### 1. Candidate Watercourse Selection

In 1993, DNRC asked interested individuals, organizations, and other agencies to compile a list of watercourses that might benefit from the installation of measuring and controlling devices. DNRC subsequently screened more than 150 suggested watercourses and selected ten initial candidates to study, of which the Big Hole River was one. Selection was based on local interest in the watercourse, the amount of information available, and the likelihood that the watercourse would meet statutory criteria for designation as chronically dewatered watercourses under MCA 85-2-150.

Other streams evaluated under the Water Measurement Program include Mill Creek (Yellowstone Basin), One Horse Creek (Bitterroot Basin), Tenmile Creek (Missouri Basin) and the Musselshell River. A final report for Mill Creek was written in 1993 and measuring and controlling devices were required by DNRC for all diversions. Measuring devices on Mill Creek will help to monitor a Montana Fish, Wildlife and Parks (MFWP) water right lease and will ensure higher instream flows to protect fisheries. The devices on Mill Creek will also help irrigators to better allocate water. Measuring devices were not required for One Horse Creek as it was determined during the study that senior water right holders were already measuring their water and additional devices could not help water right holders or increase instream flows. Shortly after the initial scoping meeting for Tenmile Creek, the local water commissioner required measuring devices for all diversions and the study was subsequently discontinued. The entire length of the Musselshell River was designated as chronically dewatered. Measuring and controlling devices are required on all Musselshell diversions by April 1, 1997. Rock Creek (Yellowstone Basin) and the Jefferson River are being evaluated concurrently with the Big Hole. Additional watercourses will be studied as the program progresses.

### 2. Legal Guidelines

To guide DNRC in deciding whether to designate a watercourse as chronically dewatered, the legislature spelled out nine factors for consideration (85-2-150, MCA). These factors include but are not limited to:

(1) extent, duration, and frequency of the dewatering;
(2) impact of the dewatering on fish, wildlife, or other natural resources;
(3) particular species of fish and wildlife impacted;
(4) impact of dewatering on other off-stream uses, including but not limited to agricultural, industrial, municipal, and recreational uses;
(5) probable cause of the dewatering;
(6) existence of a temporary or final basin water right decree;

(7) history, if any, of conflict among water rights holders on the watercourse;
(8) practicality and reasonableness of installing measuring devices on diversions along the watercourse; and
(9) likelihood that the installation of measuring devices would significantly help
  (a) solve the chronically dewatered condition of the watercourse; or
  (b) resolve conflicts among water rights holders on the watercourse.

### 3. Public Information and Participation

Informing and involving the public during the water measurement study process is a primary objective of DNRC. DNRC holds two rounds of public meetings as part of the study process for each watercourse. Each public meeting is advertised in local news media. A notice is sent to all water right holders on the watercourse or portions of the watercourse, and to various agencies and private interest groups.

The first round of meetings consists of the initial scoping meetings to discuss the watershed and assess local interest. State and local agencies, together with the public and private interest groups are encouraged to provide comments and ideas to be used in the development of a draft study report.

Scoping meetings for the Big Hole Study were held in Divide and Wisdom. Attendance at the meetings is summarized in Table 1 below:

**Table 1. Scoping Meetings**

| Meeting | Date | Attendance |
|---|---|---|
| Divide | March 8, 1995 | 59 |
| Wisdom | March 9, 1995 | 29 |

A total of 39 issues were raised during the Divide meeting and 25 issues during the Wisdom meeting. These issues are presented in Appendix A.

DNRC received 15 letters regarding the Big Hole River as of May 1, 1995. Twelve letters supported requiring installation of measuring devices and three letters were against.

The second round of public meetings will be held during a 45-day review period that will follow publication of this draft study report. The purpose of these meetings will be to present the findings of the draft report and receive comments to be considered in a final report. Based on the findings of the watercourse study, DNRC will determine and record in the final report whether to designate the Big Hole River as chronically dewatered and subsequently require measuring and controlling devices for all main-stem water diversions.

# V. EXISTING SITUATION

## A. Big Hole Basin Description

The Big Hole watershed is in the Missouri River basin. The Big Hole received its name from early trappers, who called valleys "holes." Since the headwaters region was a particularly large valley, it earned the name Big Hole (Fischer, 1986).

The Big Hole is a rural area of small towns and widely scattered ranches. Land uses in the Big Hole basin are mostly agricultural and recreational. The main agricultural uses are raising livestock (cattle and sheep) and growing crops (hay and alfalfa) to support the livestock industry. Population centers are Jackson, Wisdom, Wise River, Divide, Melrose, and Glen.

The length of the Big Hole River traces roughly an "S" shape (Figure 1). From its headwaters above the town of Jackson, the Big Hole flows to the north, then curves to the southeast around the Pioneer Mountains along Highway 43 to the town of Divide. From Divide, the river flows south to Glen, then curves to the northeast around McCartney Mountain at the southern tip of the Highland Mountains and joins the Beaverhead River to form the Jefferson River approximately two miles north of the town of Twin Bridges. The total length of the Big Hole from the headwaters at Jahnke Creek to the mouth is approximately 130 miles. Most tributaries to the Big Hole originate in the mountain ranges above Divide. The Big Hole River's largest tributary is Wise River, which flows from the Pioneer Mountains.

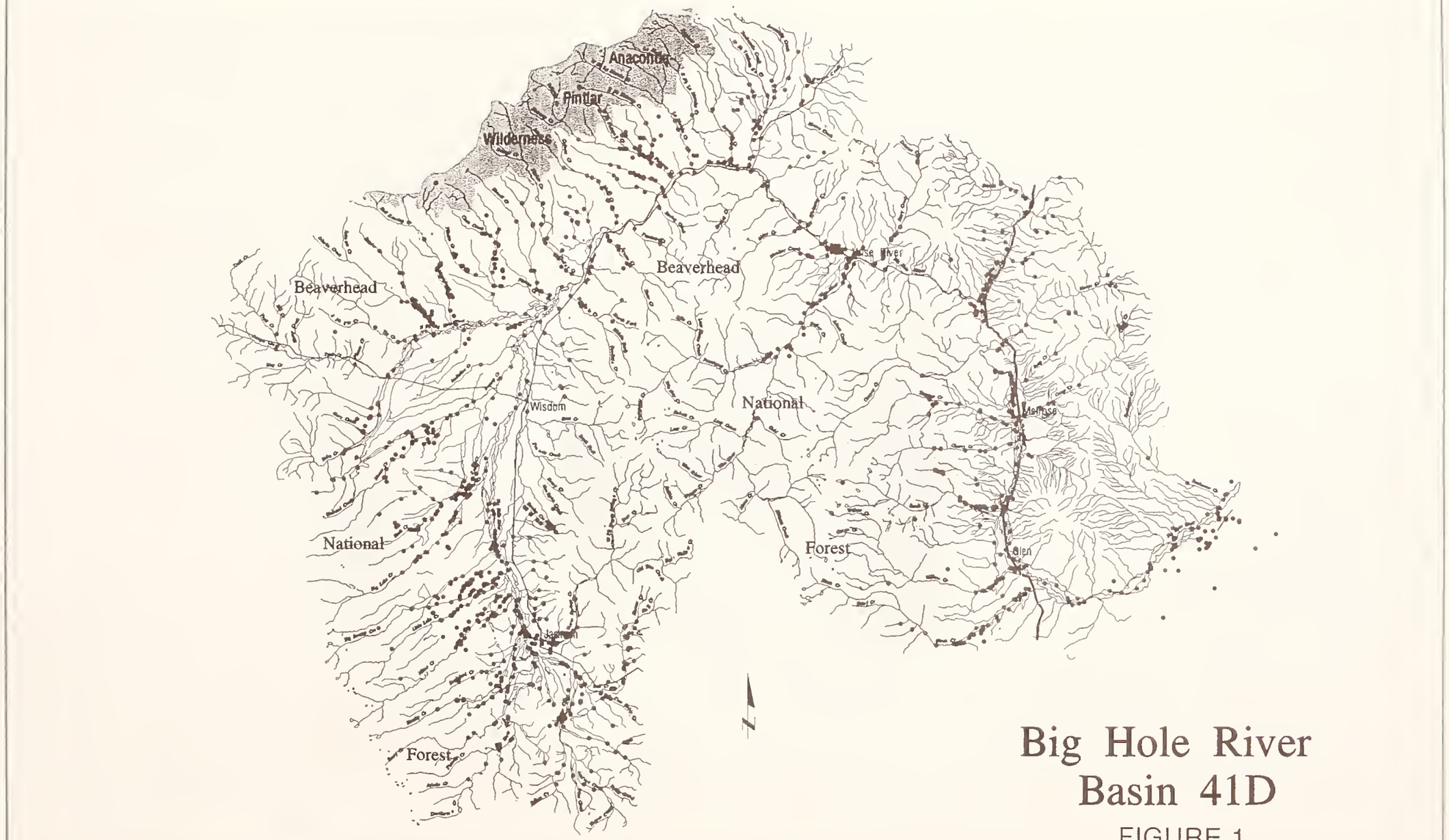
For the purposes of this study, the Big Hole is divided into two portions. The division of an upper and lower basin is made based on locations of river flow gaging stations and differences in agricultural crop requirements and water use. The upper basin includes the river basin upstream from the Melrose gaging station (about 7 miles downstream from Melrose) including the Wise River drainage; the lower basin includes all of the watershed from the Melrose gaging station downstream to the river's confluence with the Beaverhead Rivers.

### 1. Upper Big Hole Basin

The upper Big Hole Basin above Pintlar Creek is a partially glaciated intermontane valley. The upper basin valley is flanked on the west and north by the high, rugged Bitterroot and Anaconda ranges. The Pioneer Mountains form the eastern side of the Big Hole above Fishtrap. Below Pintlar Creek, the river flows through sections of canyon and narrow valley that widens near Wise River and below Melrose.

In general, the mountainous portions of the Big Hole River basin are forested and the mountain valleys grow grass and sagebrush. Upland terraces grow Idaho fescue and green needlegrass, merging into sagebrush in the foothills. Subirrigated portions of the basin floor along the Big Hole River valley and the river's major tributaries are grasslands.

Upper basin agricultural crops are predominately grass hay. The growing season in the upper basin averages sixty-eight days (DNRC, 1981). Approximately 136,000 acres are irrigated in the upper basin.




# Big Hole River Basin 41D

FIGURE 1

## Legend

- Irrigation PODs, Surface Water
- National Forest
- Wilderness

Scale = 1:209000

0 5 10 15

Miles

Albers Conic Equal-Area Projection

5

### 2. Lower Big Hole Basin

The lower basin (below the United States Geological Survey (USGS) Melrose gaging station) is mostly open valley with rolling hills and dry hillsides that rise up to forested mountaintops. Needle-and-thread grasses grow in the lower areas, merging into sagebrush in the foothills along the mountains and in the higher mountain valleys.

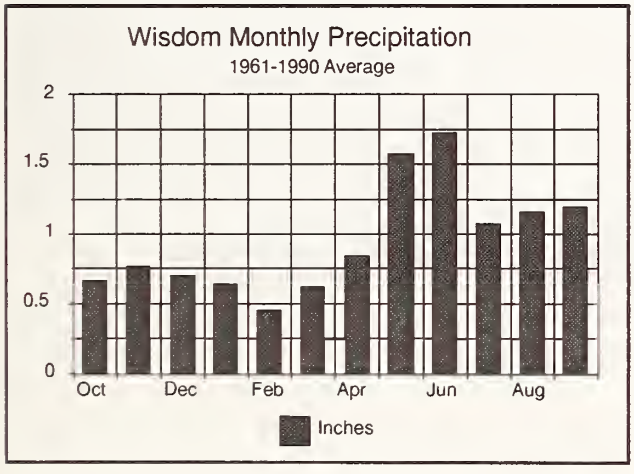
The growing season in the lower basin near Twin Bridges averages 126 days (DNRC, 1978). Lower basin agricultural crops are predominately high-water-using crops such as alfalfa. A DNRC inventory (1981) identified 21,679 irrigated acres in the lower basin.

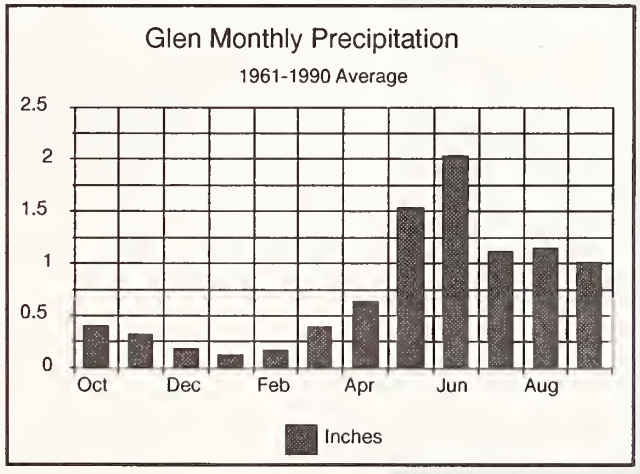
The Big Hole flows through mostly open valley ranch land in the lower basin. Below Glen the river becomes increasingly braided. In the vicinity of Twin Bridges, irrigation water is taken from the various sloughs and channels of the Big Hole River. Approximately 24,787 acre-feet (af) of water are diverted from the lower Big Hole basin to the Beaverhead River basin annually (DNRC, 1981). This diversion estimate includes water from Willow Creek and Birch Creek near Glen.

## B. Basin Hydrology

Weather records indicate that annual precipitation averages 13 inches at Jackson, 12 inches at Wisdom and 9 inches at Glen. The months of May and June typically receive the greatest amount of precipitation. The average monthly precipitation values for 30 years of record for Wisdom and Glen are presented in Figure 2 below.

Figure 2




### 1. Groundwater

Pre-Tertiary basement rocks and Tertiary and Cretaceous igneous rocks constitute the crystalline rocks of the surrounding mountains and are buried beneath valley sediments. Approximately 16,000 feet of Tertiary sedimentary rocks have been deposited in the greater part of the basin. These rocks are overlain by surficial Quaternary glacial-outwash deposits, glacial till and alluvium.

Wells in the upper Big Hole valley are nearly all completed in the shallow Tertiary rocks and Quaternary sediments which consist mainly of permeable sands and gravels and are generally less than 1000 feet thick (Levings, 1986). Most wells are completed in the sedimentary aquifer within 125 feet of the surface. Wells in the upper Big Hole have an average depth of 97 ft and an average pumping level of 41 feet (DNRC, 1978). Some areas of the lower basin currently depend on groundwater for irrigation.

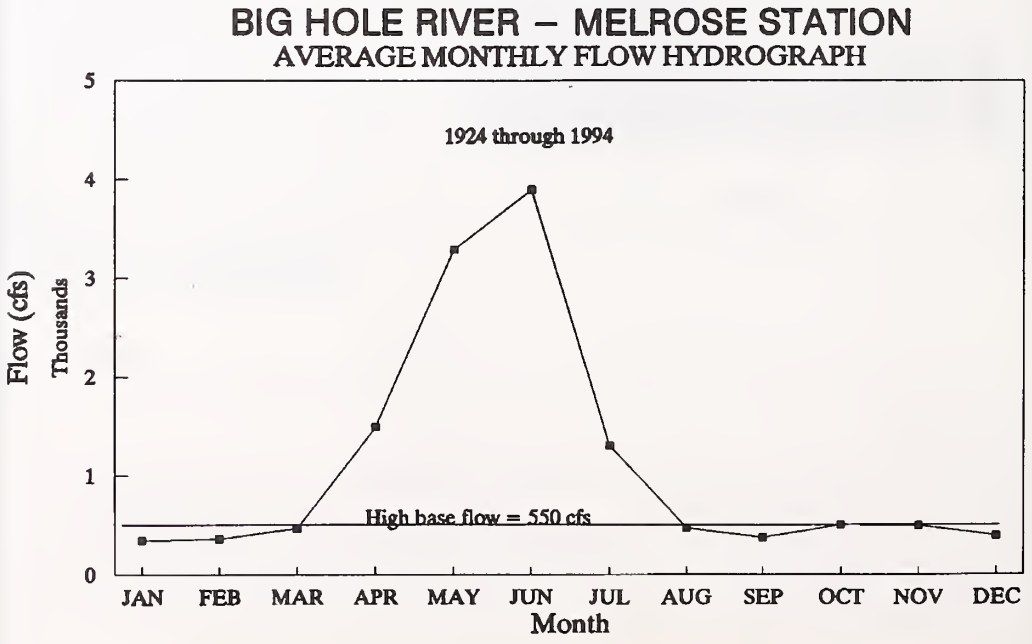
Shallow groundwater is common in the Big Hole River valley bottomlands and locally near springs, seeps, and ditches that contain water throughout the growing season. Shallow groundwater under much of the irrigated land affects crop productivity and can result in lower yields. Shallow groundwater in the basin generally flows toward the Big Hole River. By mid-August, most instream flow is derived from groundwater. A study by Levings (1986) determined that the net recharge to the upper basin ground water aquifer above Mudd Creek, from irrigation and precipitation normally ends in mid-July.

Recharge to the groundwater system is through infiltration of precipitation on the surface, and from infiltration of stream channels, ditches and flood irrigation. Existing well data indicate that net seasonal recharge to the ground-water system begins in early spring after the ground thaws, and ceases by early summer as streamflow runoff decreases and evapotranspiration losses increase (Leving, 1986).

### 2. Surface Water

Spring runoff generally occurs in late spring and early summer and results in 40-60 percent of the annual water production from the basin. High flows occur in April, May, June and July. The mean annual river discharge recorded by the U. S. Geological Survey near Melrose for water years 1924-1994 is 1,118 cfs or 809,800 acre-feet per year. A hydrograph showing average annual flow for the Big Hole River at the Melrose station (Figure 3) indicates that summer instream flows are lowest during the months of August and September. The increase in instream flow that typically occurs in late September is due to seasonal cooling, less evaporative losses, and the end of the irrigation season.

Figure 3



The three largest tributaries to the Big Hole are Trail Creek, Deep Creek and Wise River. During most years, these tributaries produce approximately 30 percent of the total flow recorded at the Melrose gaging station.

Water enters the basin as precipitation and leaves the basin as surface flow in the river, as groundwater underflow, and through evapotranspiration. Evapotranspiration refers to the consumptive use of water due to direct evaporation from surface-water bodies and from the soil, and from transpiration from plants. A study of the upper basin by Levings (1986), compared recharge *to* and discharge *from* the basin. Water losses to evapotranspiration were calculated to represent approximately 73 percent of the total discharge from the upper basin.

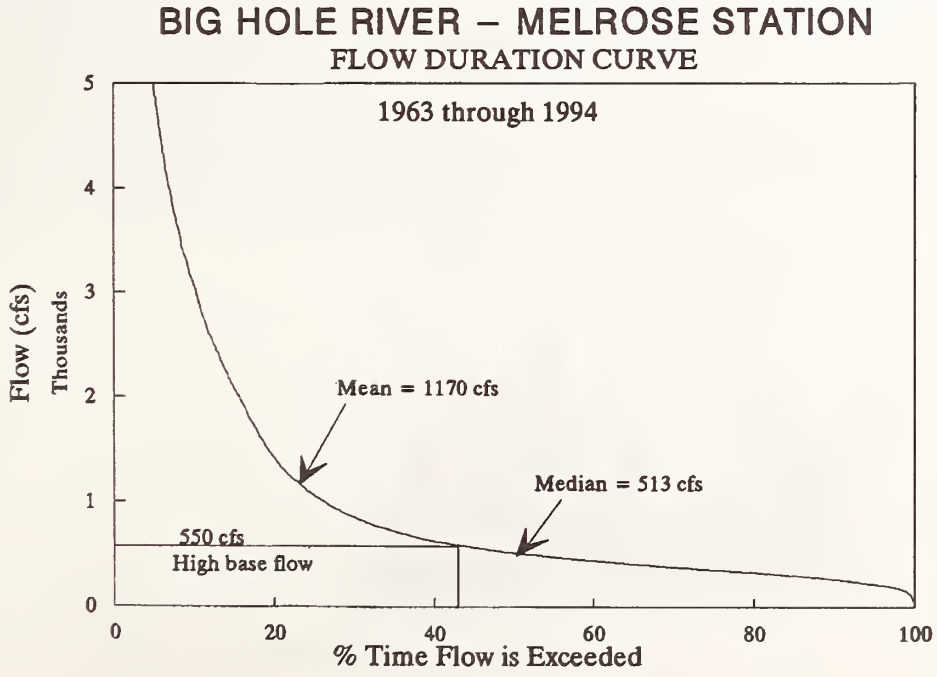
A flow-duration curve has been plotted for the Big Hole River near Melrose for 31 years of record (Figure 4). The curve shows the percentage of time that a certain discharge is equaled or exceeded. This curve was used to determine basin runoff characteristics.

The steep part of the curve represents streamflow which is mostly derived from surface runoff. The gentler slope represents base flow or that part of the discharge which results from groundwater seeping into the stream. The average annual high base flow has been estimated from the break in slope at approximately 550 cubic feet-per-second (cfs). The median discharge at the Melrose station is 513 cfs and the Mean discharge is 1170 cfs. The mean discharge is equaled or exceeded approximately 20 percent of the time, usually in May and June.

## C. Existing Water Uses

There are several competing beneficial uses for limited flows in the Big Hole River. Existing water uses include: agriculture, domestic, municipal, fisheries and recreation. Currently, the greatest demands on the river are for irrigation and fishing. Water shortages for beneficial uses typically occur between mid-July and September.

Figure 4



### 1. Agriculture

Agriculture that supports the area's economy depends on water. The main agricultural uses are raising livestock (cattle and sheep) and growing crops (grass hay and alfalfa) to support the livestock industry. Most of the water diverted from the Big Hole River goes to irrigated agriculture. Water diversion locations in the Big Hole Basin are shown on Figure 1.

Irrigators in the upper basin flood irrigate because the climate supports production of grass hay; crops that would bring a higher return and support more efficient but expensive systems such as sprinkler irrigation will not grow. Due to the relatively short duration of the growing season, ranchers in the upper valley obtain only one cutting of hay per year. Typically, the hay fields are irrigated until about the middle of July. The fields are then allowed to dry for several weeks before the hay is harvested.

Alfalfa is the dominant crop in the lower basin. Most irrigation in the lower basin is flood irrigation. However, many irrigators have switched to wheel-line sprinkler systems in recent years. Due to the longer growing season in the lower basin, irrigators can harvest more than one cutting of alfalfa.

### 2. Domestic

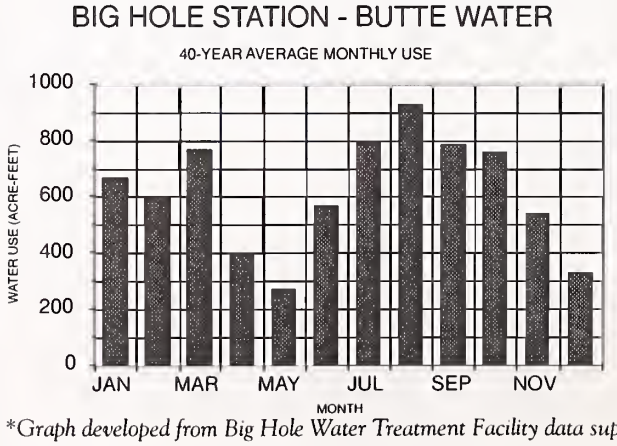
Most domestic water rights for Big Hole River water are for irrigation of lawn and garden plots which are generally less than 5 acres. A few of the tributaries to the Big Hole have minor water rights for in-house domestic needs.

### 3. Municipal

Most of the communities along the Big Hole rely on groundwater which requires less treatment than river water for municipal uses.

The largest municipal user is the City of Butte, which diverts an average of 7,100 acre-feet of water annually from the river near the old Divide Dam through three pipelines, two 26-inch and one 36-inch. The capacity of the Butte pipelines is roughly twice the amount that is now diverted. Butte's average daily use from the Big Hole is 19 acre-feet per day. An acre-foot of water will cover one acre of land one foot deep and is the average amount of water necessary to supply a family of five for one year. Butte's highest monthly water use typically occurs in August. The 40-year average monthly water use by the City of Butte is presented graphically below.

Figure 5




*Graph developed from Big Hole Water Treatment Facility data supplied by Tim Miller (1995).*

The Butte Silver Bow Water Utility Division that supplies water to Butte from the Big Hole has a water right for 21.26 cfs, and 15,426.5 af per year. The water right priority date is 1901.

### 4. Fisheries

The Big Hole River and its tributaries supports abundant populations of brook, brown, rainbow, and cutthroat trout.

The drainage supports a renowned fishery and is highly valued for its population of native stream-dwelling arctic grayling. Spawning by arctic grayling has been documented in the Big Hole River and the North Fork of the Big Hole and Big Lake, Rock, Steel, Deep, Governor, Lamarche, Fish Trap and Swamp creeks (Byorth, 1995). Besides providing spawning habitat for grayling, Deep Creek provides spawning habitat for rainbow and brown trout from the Big Hole river.

### 5. Recreation

The Big Hole River is very popular with Montana residents and is nationally known. There are 15 developed recreation sites on the Big Hole. Fishing is the primary recreational activity within the drainage.

Angler use is dispersed throughout the drainage, but heaviest use occurs on the Big Hole below Pintlar Creek. The Big Hole River is second only to the Madison in fishing pressure in the upper Missouri basin. From March 1993 to February 1994, the MFWP estimated that the middle reach of the Big Hole between Pintlar Creek and Divide Creek had 35,283 angler days, and the reach from Divide Creek to the mouth had 27,964. An angler day is defined as any fishing excursion to a particular reach within a 24-hour period. The upper reach of the Big Hole and most tributaries receive low angler use.

The Big Hole can be floated as far up as Jackson, but the most heavily floated segment is from Divide to Glen (Fischer, 1986). Reaches of the Big Hole above Wisdom and from the Glen bridge to the mouth typically have low summer flows that limit floating.

The Big Hole also has opportunities for shoreline activities such as picnicking, tent and car camping, and hiking. Tributaries with high recreation use are Canyon, Wyman, Birch, and Seymour creeks and the upper reaches of Trapper Creek. Other tributaries in the Big Hole drainage have moderate to low use.

# VI. CONSIDERING ALL FACTORS FOR DESIGNATION AS A CHRONICALLY DEWATERED WATERCOURSE

The factors that DNRC uses as guidelines to determine whether to designate a river as a chronically dewatered watercourse are considered in the following subsections.

## A. Extent, Duration, and Frequency of Dewatering

The Big Hole commonly experiences sporadic dewatering to the point of creating water shortages and significantly lowering the river's high water quality. During low flow, and particularly drought years, the river is dewatered enough to threaten the aquatic ecosystem.

Low flows during the drought years of 1988 and 1994 brought attention to the dewatering problems of the river. The cooperation of local irrigators in 1994 prevented portions of the river from becoming completely dry. Hydrographs showing average daily flow past the Melrose gaging station for the drought years of 1988 and 1994 are presented as figures 6 and 7.

The USGS gaging station near Melrose has been operated since 1923. There are diversions for irrigation of about 136,000 acres upstream from the station. Monthly mean flows are plotted in Figure 2. The mean flow during July for water years 1924 through 1994 is 1,305 cfs. The mean August flow is 471 cfs and the mean September flow is 378 cfs. From the 15th of August until October during the drought year of 1994, flows at the Melrose gage were below 200 cfs. During August of 1988, flows dropped below 100 cfs.

Figure 6

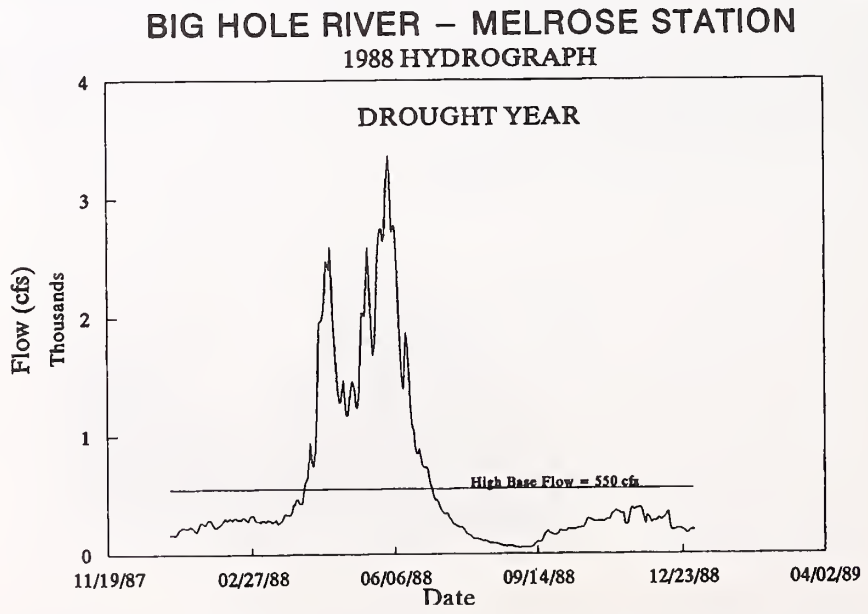
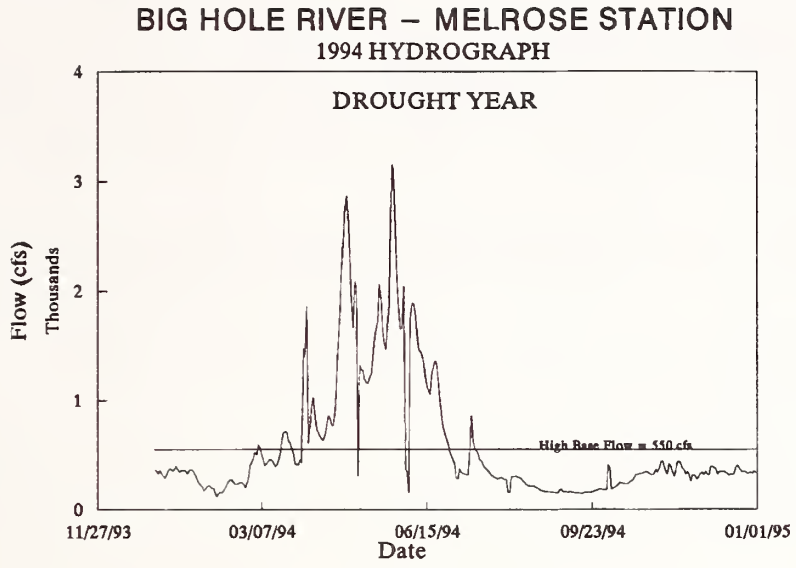


Figure 7




The USGS also maintains a flow gage near Wisdom on the downstream side of the State Highway 43 bridge over the Big Hole. The gage has been operated seasonally (April through September) for the past 7 years. Approximately 66,900 acres are irrigated in the basin upstream from the gage. The mean flows for July, August, and September for water years 1988-1994 are 156 cfs, 53.5 cfs and 30.1 cfs respectively. Gage records indicate that late summer flows have fallen below 20 cfs all years of record except for 1993 which was an exceptionally wet year. There was no flow past the gaging station for 27 days during the drought year of 1988.

The Big Hole River has been identified by MFWP as "significantly dewatered by man-caused flow depletions beyond the point where stream habitat is adequate for fish" (MFWP, 1991).

During the Upper Missouri River Basin water reservations proceedings (DNRC, 1992), hydrologists and water rights analysts identified the Big Hole River and lower reaches of many tributary streams as suffering from severe dewatering problems.

## B. Impact of Dewatering on Fish, Wildlife and Other Natural Resources

Dewatering of the Big Hole affects waterfowl and other birds and wildlife that commonly inhabit water environments. Reduced streamflows make waterfowl more vulnerable to predation and also limit food supplies for aquatic mammals, which render them more susceptible to predation.

Dewatering limits the grayling and trout fishery in the Big Hole drainage. Low summer flows during dry years cause elevated stream temperatures, increased algae, and reduced dissolved oxygen. Stream temperatures considered lethal to fish and associated aquatic species have been recorded at the USGS gaging stations at Wisdom and Melrose and at four additional stations monitored annually by MFWP (1995).

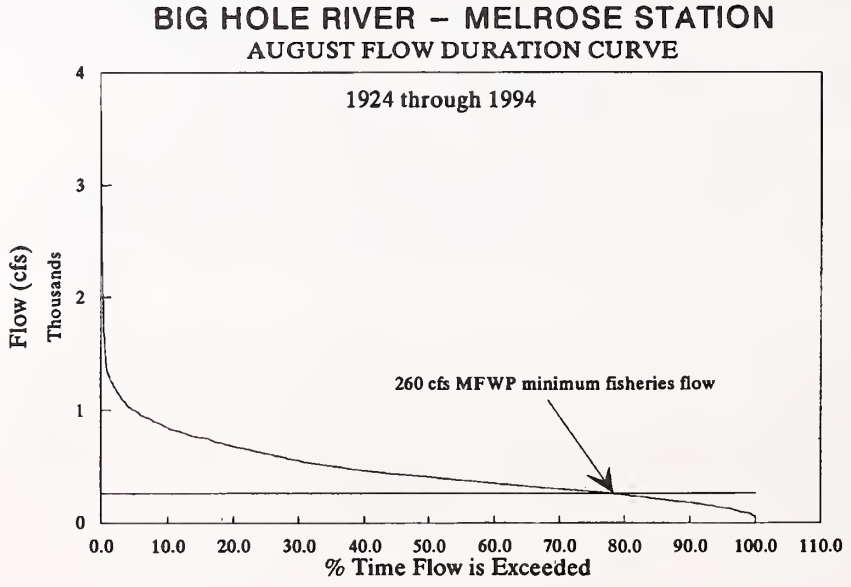
A minimum of 260 cfs has been identified as necessary to sustain the existing fishery in the vicinity of the Melrose gage (DNRC, 1992). A flow duration curve has been plotted for August flows using 70 years of flow data from the Melrose gage (Figure 8). The data indicate that during a typical August, the flow drops below 500 cfs approximately 65 percent of the time, and below 260 cfs approximately 20 percent of the time.

A minimum of 60 cfs has been identified as necessary to sustain the existing fishery in the vicinity of the Wisdom gage (DNRC, 1992). A "minimum survival" flow of 20 cfs has been defined by MFWP as necessary at the Wisdom gage to merely maintain a wetted channel and facilitate survival of the fish population only in the short term. Flows at the Wisdom gage typically drop below 20 cfs every year.

Channelization and construction of diversion works to divert water during low flows have increased stream sediment loads and turbidity. The addition of inorganic nitrogen from irrigation return flows combined with increased stream temperatures encourages algae growth. Increased algae growth reduces dissolved oxygen levels.

The limited area and duration of dewatering probably does not have a major impact on other natural resources such as trees or other plant growth in the riparian zone along the Big Hole. Some wetlands may be affected by the dewatering of the Big Hole. However, more wetlands exist along the Big Hole due to current irrigation practices.

Figure 8



## C. Particular Species of Fish and Wildlife Impacted

Information on sensitive species and plant communities was obtained from a data search by the Montana Natural Heritage Program (MTNHP). MTNHP maintains an inventory of threatened and sensitive species and plant communities in Montana. A two-mile wide buffer area along the Big Hole River was used in a data search by MTNHP. The search found various species of fish and wildlife in a rare or possibly endangered status, including: bald eagles, peregrine falcons, boreal owls, westslope cutthroat trout, arctic grayling, and the great basin pocket mouse.

Species of fish that inhabit the Big Hole and its tributaries include: mountain whitefish, cutthroat trout, rainbow/cutthroat hybrid trout, rainbow trout, brown trout, brook trout, arctic grayling, longnose dace, longnose suckers, white suckers, mountain suckers, burbot (ling) and mottled sculpin.

Reduced numbers of fish may limit the available food supply for bald eagles, ospreys, herons, mink, otters, and other fish-eating predators. Drying of the streambed eliminates aquatic insects which are the food source of many species of fish and birds. The elimination of aquatic plants due to stream dewatering may also reduce the food supply for waterfowl.

### The Big Hole Arctic Grayling

The fluvial (river dwelling) arctic grayling is a member of the trout family and native to Montana. Its large, colorful dorsal fin distinguishes it from other Montana trout. The fluvial arctic grayling is valued as a game fish, reaching lengths up to 15 inches in Montana. Food requirements of the arctic grayling are similar to those of trout except that it rarely eats other fish.

The fluvial arctic grayling was native to two areas in the lower 48 states: Michigan, where it is now extinct, and in the Missouri River drainage above Great Falls, where it was once abundant. The original range of the stream-dwelling grayling has been greatly reduced and is now limited to the Big Hole River, and some of its tributaries. Arctic grayling also live in lakes but depend on flowing water for spawning. Lake-dwelling grayling are abundant and apparently secure in Montana and other western states. Although the specific causes of decline in stream-dwelling arctic grayling populations have not been identified, low streamflows, changes in land use, and the introduction of non-native species may be among the contributing factors (DNRC, 1992).

During the 1980s, the population of grayling in the Wisdom vicinity of the Big Hole declined from 111 fish per mile to 22 fish per mile (MFWP, 1995).

A petition to list the arctic grayling as an endangered species was submitted to the U.S. Fish and Wildlife Service (USFWS) in 1991. Because of current cooperative efforts "on the ground" to sustain the grayling population, USWFS determined that "listing is warranted but precluded" (Norstrom, 1995). One of the factors used to determine whether a species is endangered is the "inadequacy of existing regulatory mechanisms." Water measurement might be considered a regulatory mechanism that could be used to help making listing of the grayling by USFWS unnecessary (Nordstrom, 1995).

## D. Impact of Dewatering on Other Offstream Uses, including But Not Limited to Agriculture, Industrial, Municipal, and Recreational Uses

### Agriculture

Shortages of water for irrigation in the Big Hole result in reduced agricultural yields. Shortages have troubled irrigators since the turn of the century. Shortages of water for irrigation were the reason DNRC conducted several dam feasibility studies in the Big Hole basin over the past 20 years. A 1980 DNRC survey of sixty-six irrigators on the Big Hole indicated that irrigators in the upper basin begin to run short of irrigation water by mid to late July in most years (DNRC, 1981). The questionnaire data also showed that irrigators in the lower basin suffer water shortages an average of one of three years.

Individual irrigators divert from tributaries and the mainstem river. Most individuals and ditch companies do not keep records of annual diversion quantities. Since present diversions are not measured, the irrigators can only estimate how much water they divert per acre. Because of limited water use data, the extent of the impact of Big Hole dewatering on agricultural productivity has never been accurately determined.

In the upper basin, most irrigated fields produce only one crop of grass hay. Most irrigators in the upper basin are through irrigating by mid to late July. However, many of the ditches and canals are left flowing full for stock water following the irrigation season. During a drought year, these ditches and canals have the capacity to completely dewater the river above Wisdom, creating shortages for water users downstream.

The irrigation season in the lower basin typically lasts from early May to mid-September. Water requirements per acre are generally higher in the lower basin where more than one cutting of alfalfa can be produced during the growing season. Water requirements for alfalfa in the Lower Big Hole basin have been estimated at 30 to 50 percent higher than the water requirements of grass hay (DNRC, 1981). High water demand, during low flow periods in July, August, and September, creates water shortages for downstream water users.

### Industrial

There have been no documented reports of dewatering impacts to industrial uses to date.

### Municipal

Both water quantity and quality affect municipal water use. The City of Butte voluntarily reduced consumption of Big Hole water during the 1994 drought. Lower instream flows decrease the water quality through higher water temperatures, increased turbidity, increased salinity, and lower dissolved oxygen levels.

### Recreation

Recreational opportunities decrease as the river is dewatered. Dewatering degrades fisheries and wildlife habitat and decreases fishing and hunting opportunities. Low flows limit floating and boat fishing. Reaches of the Big Hole below Glen are often unfloatable during July and August of average years due to dewatering.

A 1989 recreation survey and economic study of instream flows in the upper Missouri basin by Duffield (1990) was designed to provide detailed information on recreation and economics for the reservation process in the Missouri River Basin above Fort Peck Dam (DNRC, 1992). The study showed very significant recreation and preservation values associated with water in the Missouri River basin. These values varied considerably from one site to another and were highest in the Upper Missouri Basin. From the standpoint of state economic impact, far and away the most important resources in the basin are the Madison, Gallatin, Jefferson, Beaverhead and Big Hole rivers. These waters are destination fisheries. A destination fishery is a location that visitors from outside the local area travel to for the primary purpose of fishing.

Survey respondents were asked how the 1988 drought-induced low flows affected their recreation. A substantial share of respondents (52 percent of residents and 34 percent of nonresidents) indicated that they took fewer trips to upper Missouri Basin waters because of the low flows in 1988 (Duffield, 1990). Less than two percent of all respondents indicated that they took more trips due to low flows. A substantial share of respondents also indicated that the quality of their recreational experience was lower because of inadequate stream flow experienced in 1988. These results indicate that potentially significant economic impacts may be associated with low stream flows. The basic conclusion of the report was that significant recreation values are associated with upper Missouri Basin waters.

## E. Probable Cause of Dewatering

Water is diverted from the Big Hole River and its tributaries to irrigate crops, primarily grass and alfalfa for hay. Some of the water diverted onto a hay field is consumed by the crops. DNRC estimates that a stand of alfalfa in the lower Big Hole valley could transpire into the atmosphere as much as 1.75 feet of water over the course of the growing season. Put another way, a 100 acre field of alfalfa could transpire 175 af of water per year. Rain will contribute some of the required water, but most will need to be provided by irrigation. In the upper portions of the basin, the growing season is shorter and grass-hay is the primary irrigated crop. Grass generally requires less water than alfalfa. In the upper portions of the basin, grass hay crops may consume about one foot of water (1 af/acre) during a May-July growing season, some of which will be supplied by rain.

The amount of water that a rancher applies on a field usually far exceeds the amount actually used by the crop. The irrigation system efficiency is the ratio of the amount of water consumed by a crop to that diverted. For example, if alfalfa in a 100 acre field requires 100 af of water and the efficiency of the system is 20 percent, then the rancher must divert 500 af of water. The one hundred acre feet would be used by the crop, while much of the remaining 400 af may eventually find its way back to the stream via surface or groundwater return flows. Return flow is the water not used by the irrigated crop or noncrop vegetation, that reenters the stream and is available for other uses. Non-beneficial losses occur as a portion of the water diverted is consumed by noncrop

vegetation or evaporated. Typical irrigation efficiencies in the upper Missouri River basin range from 15 percent for flood irrigation systems , to about 50 percent for sprinklers.

About 158, 000 acres of land are irrigated in the Big Hole River basin (USGS 1995). A rough assumption would be that a typical acre of hay would need about one acre-foot of water beyond that supplied by summer rainfall, or about 158, 000 af of water would be needed for all irrigated land in the valley. For comparison, the average annual water yield of the Big Hole River at Melrose is about 809,000 af. The yield at the mouth of the river would be slightly larger, or about 866,000 af. Hence, irrigation may consume about 15 percent of the annual water yield of the basin. Of course, much more water than this would need to be diverted, but the irrigation return flows could be used over and over again.

Although irrigation consumes a relatively small amount of the annual water yield of the basin, peak irrigation demands generally occurs during the mid-to-late summer, when runoff has passed and streamflows are dropping. If irrigation withdrawals exceed the rate at which water is returning to the stream, streamflows will drop.

Monthly flow depletions due to irrigation for an average year were calculated by DNRC (1982) as presented in Table 2 below.

**Table 2. Monthly Flow Depletions**

| Month | Average flow depletion (cfs) | Average flow | Natural flow* |
|---|---|---|---|
| May | 1200 | 3290 | 4490 |
| June | 700 | 3897 | 4597 |
| July | 1100 | 1305 | 2405 |
| August | 400 | 471 | 871 |
| September | 150 | 378 | 528 |

**Natural flow is estimated by adding estimated depletions to existing average flow.*

Average monthly streamflows would be expected to increase by the amounts presented above at the Melrose gaging station if there was no irrigation in the basin. DNRC compared calculated natural flow values (no irrigation) to USGS streamflow records for the same time period to investigate how irrigation has contributed to dewatering in the Big Hole River. DNRC calculated that on the average, Big Hole River streamflows during the late irrigation season (July and August) have been reduced by 47 percent. During dry years, the relative effects of irrigation may be even greater.

## F. Existence of Temporary or final Decrees

Most water users on the Big Hole River appropriate water through ownership of water rights to the flow in the river. Water rights in Montana are based on the doctrine of prior appropriation, or "first in time is first in right." The earliest documented date of use determines the present order of water-use in relation to other water-users. The earlier the priority date, the more valuable the water right. A senior water right holder is entitled to use the full amount of his or her water right before any junior water right holder can use any water. However, most irrigators on the Big Hole know their neighbors and share the available water in the river.

Water rights that have been reviewed and recognized by court proceedings are "decreed" or "adjudicated rights." The Montana Water Court is responsible for the adjudication of water rights that existed before July 1, 1973. The first issuance of a decree by the Water Court is termed either a temporary preliminary decree or a preliminary decree. There are currently no final decrees on the mainstem of the Big Hole River. As of December 1, 1994, 71 percent of the water right claims on the Big Hole River (Basin 41D) had been examined by the Water Court. The final date for adjudication of the Big Hole River depends on many factors, including legislative funding for the process.

Notice of issuance of a temporary preliminary decree is given to all parties who may be affected by the decree, along with a notice of a time period for objecting to the rights in the decree. A water master will hear and decide all objections. Since water rights are based on actual use, water measurement records can be very helpful when defending a right. Although a final decree may be years away for the Big Hole, an irrigator's water right to a specific quantity of water depends on when the use of the water began. When a senior water right holder makes a call for water, upstream users are required by law to allow enough water to pass their diversion to satisfy the senior water right.

Many of the tributaries to the Big Hole have early decrees (prior to July 1, 1973) established by a district judge. These decrees are legally binding until adjudication of the basin is completed by the Montana Water Court. An estimated 70 percent of upper basin irrigators divert from tributaries.

Water rights and permits for the Big Hole basin above and below the Melrose gaging station have been summarized in Tables 3 and 4 respectively. Permits are water rights established after July 1, 1973.

## Table 3. Upper Basin - Summary of Water Rights and Permits

**Big Hole Main Stem including North and South Forks**

| Purpose | Number | Total Rate (cfs) | Volume (af) | Land Used On (acres) |
|---|---|---|---|---|
| Municipal and Domestic | 3 | 21.3 | 1527.2 | 0 |
| Irrigation | 196 | 3,069.3 | 56,309.2 | 116,917 |
| Stock | 43 | 37.7 | 27.3 | 0 |
| Fish and Wildlife | 2 | 12.5 | 1,825.0 | 0 |
| Power Generation | 2 | 1,250.0 | 912,500.0 | 0 |
| Other | 2 | 646.2 | 250.0 | 0 |
| Total: | 248 | 5,037.0 | 986,338.7 | 116,918 |

**Upper Basin - Tributaries**

| Purpose | Number | Total Rate (cfs) | Volume (af) | Land Used On (acres) |
|---|---|---|---|---|
| Municipal and Domestic | 37 | 22.3 | 4,695.3 | 26 |
| Irrigation | 1,207 | 8,642.2 | 431,862.7 | 659,053 |
| Stock | 700 | 80.0 | 6,753.2 | 0 |
| Fish and Wildlife | 5 | 2.0 | 1,669.5 | 32 |
| Power Generation | 0 | 0.0 | 0.0 | 0 |
| Other | 61 | 587.5 | 286,896.6 | 0 |
| Total: | 2,010 | 9,334.0 | 731,877.3 | 659,111 |

## Table 4. Lower Basin - Summary of Water Rights and Permits

**Big Hole Main Stem**

| Purpose | Number | Total Rate (cfs) | Volume (af) | Land Used On (acres) |
|---|---|---|---|---|
| Municipal and Domestic | 0 | 0 | 0 | 0 |
| Irrigation | 130 | 1,943.9 | 37,965.1 | 24,465 |
| Stock | 47 | 268.2 | 105.1 | 0 |
| Fish and Wildlife | 0 | 0 | 0 | 0 |
| Power Generation | 0 | 0 | 0 | 0 |
| Other | 1 | 1.5 | 825.0 | 0 |
| Total: | 178 | 2,213.6 | 38,895.2 | 24,465 |

**Lower Basin - Tributaries**

| Purpose | Number | Total Rate (cfs) | Volume (af) | Land Used On (acres) |
|---|---|---|---|---|
| Municipal and Domestic | 5 | 0.2 | 100.8 | 24 |
| Irrigation | 121 | 7,222.5 | 244,810.4 | 64,857 |
| Stock | 93 | 5.4 | 189.9 | 0 |
| Fish and Wildlife | 1 | 0 | 1.9 | 0 |
| Power Generation | 1 | 111.4 | 47,876.0 | 0 |
| Other | 22 | 37.2 | 12,961.4 | 0 |
| Total: | 243 | 7,376.7 | 305,940.4 | 64,881 |

Most water rights are for irrigation. A specific acreage might be irrigated with several separate water rights. The column in the previous tables entitled "Land Used On" indicates the total acreage that is irrigated under individual water rights; actual irrigated acreage in the basin is much less since the acreage may have more than one source of water used for irrigation and is therefore counted more than once.

The largest individual water rights are for non-consumptive power generation. The dams and power plants for these rights are no longer used. The power generation rights were claimed in 1982 by the Montana Power Company . The water rights adjudication process will determine the extent of these water rights.

Most water right priority dates were established between 1880 and 1920. The distribution of water rights by priority date in the upper and lower basins are presented in Table 5.

## Table 5. Priority Date Distribution

| Priority Date | Upper Basin Total Water Rights (percent) | Lower Basin Total Water Rights (percent) |
|---|---|---|
| 1840-1860 | 0.04 | 0.2 |
| 1860-1880 | 2.6 | 10.2 |
| 1880-1900 | 36.7 | 34.2 |
| 1900-1920 | 48.1 | 40.6 |
| 1920-1940 | 5.3 | 7.8 |
| 1940-1960 | 3.8 | 3.6 |
| 1960-1973 | 2.7 | 1.9 |
| 1973-1995 | 0.8 | 1.4 |

The Big Hole basin was closed to additional permits to appropriate water on April 16, 1993. Exceptions to the closure include groundwater, nonconsumptive uses, domestic or municipal uses and stock water use.

The Board of Natural Resources and Conservation granted instream water reservations on the Big Hole River to MFWP in 1992. Under Montana law, reservations allow for maintaining instream flows to protect aquatic life, recreation and water quality. The priority date of the MFWP reservations is July 1, 1985. The MFWP reservations have "no force and effect" on existing water rights in the Big Hole as long as the basin is closed.

## G. History of Conflict

Most water conflicts along the Big Hole have historically been settled at a local level. Currently, water management on the Big Hole is achieved through informal communication among water users on a given ditch or stream reach. Local users know the needs of their neighbors, share the resource, and maintain communication regarding water issues to avoid conflicts.

During summer months there isn't enough water to meet competing needs. As the population of the valley increases and more recreationists and recreation based businesses move into the basin, competition for the limited water supply will increase. As properties are bought and sold, the old system of sharing the limited resource between neighboring ranches may no longer be an option. Conflicts are likely to increase in the future.

Conflicts exist between irrigators and recreationists who believe the irrigators are taking more water than they have a legal right to. Demand for increased instream flows has resulted in increased scrutiny of water users. Recreationists believe that many irrigators are using more water than is necessary to sustain their operations. Recreationists and conservationists believe that if irrigators are more accountable for water used, instream flows will increase for recreation and fisheries purposes.

## H. Practicality and Reasonableness of Installing Measuring Devices

Examples of measuring devices that would be adequate for this area include Parshall flumes, weirs, constant head orifices, long-throated flumes, propeller flow meters, and metergates. Many of the diversions on the Big Hole consist of permanent structures that could be rated to measure water. A few diversions in the basin already have suitable measuring devices in place. Assistance in selecting the type of measuring device and the capacity design is available from DNRC, the Natural Resources Conservation Service (NRCS), Montana State University's Extension Service, manufacturers and suppliers of measuring and controlling devices, and natural resource consultants.

The cost to acquire, install, and maintain measuring and controlling devices will vary with the size, type, and location of the devices. In some instances, several water users on a single canal will be able to share the cost of a single measuring device at the headgate.

Financing sources may include DNRC's Renewable Resources Grant Program, NRCS, and local banks or other lending agencies. Most of the funds available from DNRC Renewable Resources Grant Program must be applied for by a public entity. For example, the local conservation district could apply to the program in order to receive funds for measuring and controlling devices on several canals.

Funds are currently available to individuals through the Renewable Resource Grant Program for 25 percent of the total project costs (measuring device and installation) up to a $5,000 maximum grant. A two-page application can be obtained from DNRC.

Additional funding may be available from federal grant programs and private conservation groups.

Many different types and styles of measuring devices are available commercially. The physical characteristics of the canal or ditch including the size, location, canal slope, and other site characteristics sometimes limit the availability of some types measuring devices, but usually more than one type will work.

If the site conditions are favorable, Parshall flumes are available from a number of steel suppliers. The cost of the flume varies with the width and depth of the flume throat. The approximate cost of prefabricated steel Parshall flumes for varied flow capacities is presented in the Table 6.

## Table 6. Cost Estimate for Prefabricated Steel Parshall Flumes

| Unit Cost | Measuring Capacity |
|---|---|
| $400 to $600 | 0 to 15 cfs |
| $700 to $900 | 15 to 30 cfs |
| $900 to $1500 | 30 to 60 cfs |
| $1500 to $1800 | 60 to 100 cfs |
| $1800 to $2000 | 100 to 150 cfs |
| $2000 to $2400 | 150 to 200 cfs |

**Table is based on price lists from local suppliers.*

Costs for shipping and installation are not included in the above figures. Installation of a Parshall flume usually requires a backhoe and generally takes less than a day.

Some ditches and canals may have a suitable structure or reach that could be rated to measure water. The flow can be measured by reading a permanently installed staff gage mounted on an existing structure or in the canal itself. A porcelain graduated staff gage costs about $10 a foot. A water technician needs to measure flows and establish a rating table reflecting depth at various flows for the specific site. Costs for each visit by a technician may be in the range of $35 to $60 per hour. Most sites could be measured in a few hours. If several ditches were measured at the same time, the travel costs for each site could be reduced. Most sites would require measurements two to three times during the first irrigation season to develop the rating curve. Additional measurements may be required periodically as conditions in the canal change.

Flow meters are the usual method of measuring flows when a pump diversion is used. Installation of the unit generally requires welding equipment and 1-2 hours labor. Instrument costs from one Montana supplier are shown in Table 7.

## Table 7. Cost Estimate for Pipe Flow Meters

| Pipe Diameter | Unit Cost | Measuring Capacity |
|---|---|---|
| 4-inch | $860 | 50 to 600 gpm |
| 6-inch | $1000 | 90 to 1200 gpm |
| 8-inch | $1200 | 100 to 1500 gpm |
| 10-inch | $1500 | 125 to 1800 gpm |
| 12-inch | $1800 | 150 to 2500 gpm |

**Table is based on price lists from local suppliers.*

Weirs are probably the simplest and cheapest devices that can be used to measure water in canals and ditches. A weir can be used most effectively when there is a fall of about 0.5 foot or more in the canal or ditch. Installation costs of weirs are site specific. Weirs can be constructed on site with lumber, steel or concrete.

## I. Likelihood that the Installation of Measuring Devices Will Significantly Help To:
### (i) Solve the Dewatered Condition of the Big Hole
### (ii) Resolve Conflicts

Measuring devices can be used by irrigators to determine best management practices for irrigating which could lead to water conservation when instream flows are low. Irrigation efficiency may increase as irrigators learn how much water to apply and avoid applying excess water during the critical low flow periods that typically occur during July, August, and September. Any conservation of water that can be achieved will benefit instream flows.

During the drought of 1994, many irrigators in the Big Hole voluntarily reduced consumption to increase instream flows. Through the cooperation of the ranching community, instream flows were kept from becoming critically low. Hydrographs for the drought years of 1988 and 1994 are presented in Figures 4 and 5. Higher instream flows were achieved in July and August of 1994 than during the same months of 1988, even though 1994 was an equally severe drought year, because of this cooperation.

An example of increased instream flow due to conservation has been documented by Byorth (1995). During a drought year, many of the ditches and canals on the upper Big Hole have the capacity to completely dewater the river. In 1994, flow was voluntarily reduced in some ditches above Wisdom that were used to transport stock water. Instream flows increased at Wisdom following this upstream reduction of water diversions.

If an irrigator is able to demonstrate water conservation through water measurement and increased efficiency, the salvaged water may be used by the irrigator to increase production or can be leased to private or public entities for instream flow purposes. The salvaged water law (MCA 85-2-419) is presented as Appendix B.

Allocation of water on the basis of water right priority on the Big Hole through water measurement also might increase instream flows. Since most irrigators on the Big Hole do not measure water and do not keep records, most appropriators do not know whether their water right is being infringed upon by a junior water right when flows are limited. Allocation of water within legal rights during the late summer periods of low flows would increase instream flows in some reaches when junior water right holders

would be required to shut off in order to satisfy senior water rights farther downstream. If an irrigator is taking more water than he has a right to during these months, the result is less water in the river.

In order for fair allocation of water according to the doctrine of prior appropriation, knowledge of actual water use is critical. During drought years, proper allocation of water may help prevent conflicts. If an irrigator uses more water than he or she is entitled to, downstream water users are adversely affected.

Water measurement may also reduce conflicts between recreationists and irrigators. By measuring water, irrigators can demonstrates responsible management for water diverted under their water rights.

# VII. COMPARISON OF ALTERNATIVES

There are three alternatives currently available to DNRC regarding designation of the Big Hole River as chronically dewatered; (1) to designate specific reaches of the Big Hole, (2) to designate the entire main-stem including the North Fork , or (3) to take no action. These alternatives are discussed in sections A, B and C below. Alternatives were developed from issues identified through the initial scoping process with public involvement, and are intended to address those issues.

During the initial scoping meetings, alternate ways to mitigate the dewatered condition of the Big Hole were suggested. Although these options are not related to whether the Big Hole currently meets the criteria for designation as a chronically dewatered watercourse, these options have been investigated briefly in section D below.

## A. Water Measurement on Select Dewatered Reaches

Under this alternative, measuring and controlling devices would be required only on selected dewatered reaches of the Big Hole.

## B. Water Measurement for Entire Big Hole Main Stem

Measuring and controlling devices would be required under this alternative for all diversions of water from the Big Hole River including the North Fork.

## C. No Action

If DNRC does not designate the Big Hole as a chronically dewatered watercourse, consumptive water use would probably remain stable. The Big Hole River would continue to be dewatered, resulting in water shortages for some water users and adverse impacts to water quality, aquatic life, wildlife, and recreation. Under the no action alternative, conflicts between water right holders, and between water right holders and recreationists would continue and probably increase.

## D. Additional Options to Prevent Dewatering

Several options were suggested during the initial scoping meetings as ways to solve the dewatered condition of the Big Hole. Some of the participants at the meetings stated that if the dewatered condition of the Big Hole could be mitigated through other means, designation of the Big Hole as a chronically dewatered watercourse might be unnecessary. DNRC must make its determination based on the criteria established by law. Whether or not the Big Hole is designated as chronically dewatered, the options discussed below could be utilized to help mitigate the dewatered condition of the river.

### 1. Water Storage

The 1979 Montana Legislature directed DNRC to conduct a water demand survey in the Big Hole basin and to study tributary storage sites. A 1981 report by DNRC recommended further analysis of a storage facility on Pattengail Creek. This site was later determined to be economically unfeasible.

A possible storage project on Ruby Creek, a tributary of the Big Hole River, is being considered by the Bureau of Reclamation. The project would be intended to store water to supplement late season irrigation on 5,000 acres and to provide instream flows, primarily for the arctic grayling in Swamp Creek, a Big Hole grayling spawning tributary near Wisdom. Funding for a feasibility study of the project is being sought from DNRC's Water Renewable Resource Grant Program. If present trends hold, few large storage projects will be built over the next 20 years.

The contribution to instream flows of nonstructural methods of storage such as irrigation return flows currently is not well defined in the Big Hole basin. Virtually everyone agrees that irrigation contributes to groundwater which feeds the river through base flows during the late summer. However, the significance of these return flows to instream flows in specific reaches is unknown. This issue will be addressed in a study by the Montana Bureau of Mines and Geology in the summer and fall of 1995.

### 2. Groundwater Development

The local geology of the Big Hole basin suggests that there is limited potential for the development of groundwater.

Wells for irrigation in the upper basin probably would be too expensive to be practical. Well installations, pumps, power pipelines and sprinkler equipment would not make economic sense for one crop of grass hay per year. However, after July 15 when most irrigators in the upper basin are no longer irrigating, wells could be used to supply stock water and diversions could be closed to increase flows in the river. Wells might be economically feasible in the lower basin to irrigate higher yield crops such as alfalfa.

### 3. Conservation

Conservation methods that could be used in the Big Hole include increased maintenance of ditches and canals, lining ditches and canals and installing pipelines to reduce the amount of water lost in transport. Pipelines and wells could be used to fill stock tanks and reduce diversions for stock water. Irrigation scheduling could be used to increase flows. Leveling fields and converting to more efficient forms of irrigation might also be an option in some areas.

Flood irrigation could be replaced with sprinkler equipment where economically feasible. However, switching from flood irrigation to sprinkler irrigation can affect instream flows and water users downstream as larger tracts of land can be irrigated with greater efficiency resulting in less water entering the river as return flow.

**4. Water Leasing**

Instream flows could be increased if water rights were leased for this purpose. Recent legislation allows water leasing by private and public entities. Sportsman and recreational interests could solicit funds to lease water for instream flow. The water right would revert to the original owner after the lease period. Instream flow leasing is very complex and is only now being tested in the state.

**5. Local Watershed Management**

Local water users could work together to manage water use so that the river is not dewatered. A local watershed committee could develop and implement strategies to prevent dewatering. For example, water users could agree to reduce the amount of water diverted for irrigation when streamflows are low or to stagger irrigation withdrawals.

## VIII. PROPOSAL SUMMARY

The conclusion of this draft report is that the Big Hole River meets the criteria for designation as a chronically dewatered stream. The department proposes to require measuring and controlling devices on the entire Big Hole River including the North Fork (Alternative B). Significant benefits would result from measuring diverted water in the Big Hole Basin. Specific major findings are as follows:

- Efficiency can be improved. By measuring water use, irrigators will have the necessary information to determine best management practices which could result in conservation of water and higher instream flows.
- Allocation of water will improve through water measurement and recordkeeping. During low water periods, irrigators will be better informed as to how to fairly distribute water.
- Knowledge can be gained. The information gained from accurate water measurements can be used in future studies and for management decisions.
- The water measurement records could be used in the adjudication process. A water user could use the water use records to defend his or her water right during objection hearings.
- Water measurement could be used as part of a local solution to address problems such as dewatering and the potential future listing of the Arctic grayling as an endangered species.

## A. Area of Jurisdiction

DNRC proposes that the main stem Big Hole River, including braided reaches from the headwaters at Jahnke Creek to the mouth near Twin Bridges, and the North Fork of the Big Hole from Ruby Creek to the mouth, be designated as chronically dewatered. Measuring devices would be required on all diversions of water from these reaches. The final decision on this issue will be presented in a final report following public review of this draft report.

Alternative A, requiring water measuring devices on selected reaches of the Big Hole, is not recommended. Dewatered reaches near the mouth of the river will benefit if measuring devices are required on all reaches upstream. All reaches of the Big Hole can benefit from water measurement.

Designation of the tributaries to the Big Hole as chronically dewatered will be decided by DNRC at a future date with additional public involvement. Water measurement on the tributaries was not included in the initial scope of this study.

## B. Reporting Requirements

It is proposed that water measurements be recorded by the owner or operator whenever the diversion controlling device is adjusted. Water measurements will be recorded at least once every three days when water is being diverted. Water measurement records must be kept by the water user. A copy of water measurement records will be submitted to DNRC's Water Operations Bureau by January 15 annually and within three weeks of a request from DNRC's Helena Regional Office Manager.

Local water users are encouraged to form their own groups which could receive the water measurement records and conduct an annual meeting. Basin committees which include representatives from all interests might be an option.

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# APPENDIX A

## BIG HOLE SCOPING MEETING

MARCH 8, 1995
DIVIDE

The meeting was held at 7:00 P.M. in the Divide Grange Hall. Approximately 59 people attended the meeting. Issues of importance and concern to those present included:

1. Are there water use conflicts?
2. Are there illegal diversions?
3. How many conflicts between irrigators are reported to DNRC per year? Historically?
4. Is the Big Hole chronically dewatered?
5. Include base line flow data.
6. Look at measuring programs in other states.
7. How often should water measurements be recorded.
8. How much water does irrigation return flows add to the river.
9. More river gages are needed. Maybe every 10 miles.
10. What is the cost of measuring and controlling device suitable to satisfy Helena.
11. Will measuring irrigation water do anything to solve the dewatering problem?
12. Specific reaches should be measured where there are problems
13. Program is needed to retain local control. Loss of arctic graying could mean federal government involvement.
14. Others (fishery groups, recreationists should share the cost of the devices.
15. Municipal water should be measured too.
16. Dewatering is impacting the fish.

17. Measuring devices should be required on the tributaries.
18. The upper Big Hole is braided. Complicates the measuring requirement.
19. Alerts of low flows should be based on science.
20. Late season low flows are natural.
21. Include the Wise River in the study.
22. What is the cost of the devices per farm or ranch?
23. What is the impact of flood vs. sprinkler irrigation on the river?
24. How many are already measuring water?
25. Flood irrigation creates groundwater which feeds the river later in the summer.
26. Need to look at all uses: fisherman, ranchers, recreationist.
27. What are the economic impacts of dewatering on recreation and tourism?
28. How many diversions are there on the main stem as opposed to the tributaries.
29. How have diversions been made without any measurement so far?
30. Is dewatering natural - seasonal?
31. Should measurements be required all year or just during the irrigation season?
32. Require measuring devices on reaches with fisheries resources.
33. If I have to install an expensive weir, I will use all my water right.
34. Consider a pilot reach for water measurement program.
35. Fishing license fees should be used to finance the devices.
36. What does the Jefferson have to do with whether or not we measure water up here.
37. Could this program be used to determine whether additional storage is necessary.
38. Grayling habitat. What's needed?
39. Recent drought is temporary. Measuring devices may not be needed.

## MARCH 9, 1995
## WISDOM

The meeting was held at 7:00 P.M. in the Wisdom Community Center. Approximately 29 people attended the meeting. Issues of importance and concern to those present included:

1. Need to micro-manage the river. Changes, subdivisions, fisheries, etc. need to be monitored.
2. Does irrigation cause dewatering?
3. Basin is over appropriated. Will water measurement help?
4. I use a parshall flume now. What will the benefits of the program be?
5. There is already a great amount of cooperation. We don't need a mandate.
6. There is no decree because there are no conflicts.
7. What is the cost of management?
8. What is the cost of the water measurement devices?
9. Are there cost share opportunities?
10. Reservoir options?
11. Late season return flows from irrigation should be investigated.
12. What about the over-use of groundwater.
13. Other uses of water besides irrigation should be looked at.
14. What is the number of diversions on the Big Hole?
15. We need more gaging stations on the main stem
16. Dept of Fish Wildlife and Parks should be required to measure their water also.
17. Isn't this an unfunded mandate?
18. The city of Butte has a water right to 820 inches.
19. What is the annual period of dewatering?
20. What about stock water use?
21. The fall dewatering is normal.

22. Type of irrigation and impact on the river. Flood vs. sprinkler irrigation.

23. Measurement data can be used to evaluate decree amounts and verify use.

24. What is the impact of dewatering on the arctic grayling.

25. How frequent will water measurements be required?

# APPENDIX B

## Salvaged Water Law

85-2-419. Salvaged water. It is the declared policy of the state in 85-1-101 to encourage the conservation and full use of water. Consistent with this policy, holders of appropriation rights who salvage water, as defined in 85-2-102, may retain the right to the salvaged water for beneficial use. Any use of the right to salvaged water for any purpose or in any place other than that associated with the original appropriation right must be approved by the department as a change in appropriation right in accordance with 85-2-402. Sale of the right to salvaged water must also be in accordance with 85-2-403, and the lease of the right to salvaged water for instream flow purposes must be in accordance with 85-2-436.

DNRC